Decision Making in the Biological Field

The 1971 W. O. Atwater Memorial Lecture

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

THE W. O. Atwater Memorial Lecture was established in 1967 by the Agricultural Research Service of the U.S. Department of Agriculture to honor the memory of a gifted scientist . . . and to recognize accomplishment in a field or discipline that relates to the problems of nutrition and feeding the hungry world.

Dr. Wilbur O. Atwater (1844-1907) was a man of many talents. He was a scientist, teacher, lecturer, administrator, and writer . . . motivated always by a deep concern for improving human welfare through better nutrition.

Dr. Atwater established the science of modern human nutrition in the United States, and directed the first nationwide program of nutrition research, centered in the Department of Agriculture. He was the first director of America's first agricultural experiment station at Wesleyan University, Middletown, Connecticut, and the first director of the Federal Office of Experiment Stations.

Dr. Atwater's most basic contributions to nutrition stemmed from his studies on food metabolism. He perfected, among other things, the first satisfactory calorimeter for measuring the expenditure of human energy.

His warnings about the dangers of overeating and lack of exercise, and the need for protein for mental and physical health are being corroborated by scientists everywhere.

Dr. Atwater wrote extensively to popularize scientific information and to arouse public interest in nutrition.

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by Dr. Jean Mayer, Professor of Nutrition
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IT is with particular gratitude that I approach the Atwater Lecture.

Gratitude in that I feel honored that my life work as a scientist has been judged by a major research agency of our Government to be deserving to share the honor of this unique Lectureship with my three illustrious predecessors. Gratitude that I have been given so large a forum and so distinguished an audience. And gratitude that the medal and Lectureship are named after W. O. Atwater, who has always been a very special hero of mine. I inherited from my father a small but distinguished collection in the history of physiology and nutrition, and my means have enabled me to add to it only very little—an early Harvey; Haller's original Elements of Physiology, volumes VI and VII, which deal with hunger and digestion; and the original work of W. O. Atwater.

I have revered Atwater not only because he was the first American nutritionist—and I can think of no science to which U.S. scientists have contributed so massive a proportion of our knowledge as to nutrition—but because he was to my mind a complete nutritionist. He was a careful experimentalist and a theoretician, who in the laboratory established on a precise quantitative basis the calorimetry of nutrition in man. He was also committed to the betterment of the lot of mankind through science. One of his aims was to determine the most inexpensive method of providing a healthful diet for all Americans and, in particular, for the very poor.

His work on human nutrition in agricultural experiment stations established in the Department of Agriculture a tradition of service to the consumer, which is one of the glories of this unique American institution. As a laboratory man who has also conducted many experimental studies on man, been engaged on several continents in technical development in nutrition and relief activities, and who, after years of calling the attention of the nation to the nutritional plight of its poor, has been called upon to advise in the development of national nutritional policies, I have developed a special feeling of kinship with Atwater. I think he would have been pleased to see his Department designated to take the lead in the national anti-hunger campaign.

Although much remains to be done, we have seen outstanding progress in the past 2 years. Food programs now cover 14 million poor Americans instead of 6 million in 1969—and cover them very much better. The food stamp program has been made free for the very poor and provides 108 dollars per family per month instead of 70 dollars; this particular program reaches close to 11 million persons and is still expanding. An improved surplus-commodity program

reaches 3.5 million persons, most of whom will become eligible for food stamps as the program expands and replaces the less satisfactory commodity program. Approximately 7.3 million children from poor families now receive free school lunches instead of 3.5 million 2 years ago. With the recent push from Congress, I hope that we shall reach the 8 to 9 million children of poor families who need the program this year, and that many will also be reached by the expanding free-breakfast program. All this means that, while there is still malnutrition due to poverty in the United States, the magnitude of the problem has been drastically reduced in the past 2 years. These recent developments show that we *can* take decisions in the biological field, and carry them through on a very large scale (even in a period of economic recession and budgetary restrictions), as long as we make the ethical choice clearly, and the method of execution is well established and relatively simple.

I

UNFORTUNATELY, of course, most of our problems are more complicated than that of feeding the poor in a country that can produce greater and greater surpluses of food. Many decisions in the biological field are regulatory decisions. They limit the choices open to manufacturers or advertisers by ruling out the use of certain substances, or by limiting doses, concentrations, or usages, defining allowable claims, or setting standards of identity. Let us look at the single problem of regulation of the steadily increasing number of chemicals in our environment.

As medicine extends its range of action, the number of possible pharmacological interventions increases. The competitive structure of our drug industry almost automatically insures that diverse molecular modifications will be sought which, while they will not modify the basic therapeutic action, will be effective at different dosages, have different rates of absorption, inactivation, and excretion, and be associated with different side effects. This variety has some advantages as well as disadvantages; but it does increase the number of chemicals that must be monitored. Many factors have necessitated an increase in the use of food additives. Among them are:

1. The geographic range of our agricultural area;
2. The size of our internal market;
3. The growing importance of food imports from distant lands;
4. The legitimate desire of our population to have available at all times of the year a variety of fruits and vegetables once limited by climate and distances;
5. The desire of women to liberate themselves from enslavement to the kitchen by replacing half of the classical "primary foodstuffs" with "convenience foods," in which the drudgery of preparation has been done by machines supervised by paid labor;
6. The enormous increase in the proportion of meals taken outside of the home (more than one-third of the meals by now are eaten out; these are based on convenience foods or on automated methods of quantity cooking); and
7. The growth of snack foods for informal eating.

I think it may be useful to note at this point that the

increase in the use of food additives is tied to the technological, geographic, and social changes I have listed, much more than it is to the economic system. It should not, therefore, come as a surprise that socialist countries, such as the Soviet Union, have as broad a range of food additives as we have in this country; in fact, they use a number of antibiotics, preservatives, and other additives that we have not used or have discontinued in this country because of doubts regarding their safety.

Agricultural chemicals, fertilizers, herbicides, insecticides, and pesticides pose a number of regulatory problems as well as environmental problems, which lend themselves particularly well to risk-cost considerations. The enormous increase in fertility and the drastic decrease in the amount of food destroyed after the harvest (as recently as a few years ago about one-third of the crops in India were still being destroyed by rodents, insects, and molds) have permitted this country to feed an ever-increasing number of people here and abroad, while decreasing the surface under cultivation. Intensive use of agricultural chemicals thus produces at the same time positive factors and negative factors in regard to conservation. This is the same situation that exists in many areas of the world (Ceylon is a noted example), where intensive use of insecticides can be a considerable plus factor for human health, while being a negative factor for many aspects of nature conservation—a more difficult problem of risk-benefit ratio to evaluate.

Finally, of course, we have the problem of involuntary additives, contaminants, and toxicants, which raises the question of tolerance. To suggest a zero tolerance would be to ignore the presence of naturally occurring substances of universal distribution, such as mercury. And the setting of any tolerance is always an arbitrary decision. We cannot,

after all, demonstrate safety. We can only determine a threshold level of toxicity at which we observe some signs, symptoms, or morphological abnormality, then arbitrarily decide how much below that level we shall consider the concentration to be safe.

We may decide, for example, that one-hundredth of the toxicity threshold will be considered "safe." But consider the case of vitamin D. A level of 2000 units a day or more can be shown to produce growth retardation in children, that is, to be toxic. At a level one-hundredth of this—20 units—a growing child would rapidly develop rickets for lack of vitamin D. The recommended daily allowance is 400 units, only one-fifth the toxic level. And, of course, the determination is more complicated if our toxicity data, for a "natural" as well as for a new molecule, involve translation from one species to another, or if the cause of toxicity at high concentration is difficult to identify. All too often, the public does not understand that in order to determine a safe dose for any compound, the first step is to describe the toxicity symptoms at high concentration.

The role of regulatory agencies is growing rapidly because of the growth of technology to fulfill increasing demands, because of the mounting concern over the ever-increasing number of molecules used in industrial processes, and because of new preoccupations with the nature of both our drug and our food supply. It is also growing because, as was so well demonstrated in a recent article by Michael S. Baram in SCIENCE, the judicial structure that we have developed in the course of the past three millennia does not lend itself well to regulatory decisions.

The extension of the power of regulatory agencies, in turn, poses the question of who monitors and regulates them. To have them controlled solely by politicians, or reacted

to only by the industries they regulate, is obviously disastrous. In many cases where the risk is not extreme and where there are costs and benefits on both sides of a decision, the choice cannot be a purely scientific one, it is essential that the regulatory agencies operate openly in the limelight of informed opinion. I believe that a large section of this potential informed opinion is present here tonight.

Biologists have a special responsibility to keep themselves informed of regulatory decisions and to inform the public of the scientific facts that support each of the possible regulatory options. When this does not happen, the public is either much too slow to press for action or presses for the wrong kind of action.

We obviously have, for example, a massive problem of water pollution in many areas of this country. In some of these areas, phosphates have contributed to eutrophication, in other areas they are not the limiting factors. In many cases, alkaline-based substitutes, pushed by a combination of enthusiastic but uninformed laymen and by opportunistic new firms, represent a greater threat to the biotic world of our lakes than the phosphates. A well-intentioned movement backfired when responsible authorities pleaded for the reversal of bans on phosphates in many areas. Effective action will be that much more difficult in the future.

Obviously, what was needed was solid scientific studies that took into account the geology, microbiology, flora, and fauna of each major ecological system, the technology of waste treatment, water use and contamination, the economics of the area, with master plans for each sub-unit and an overall program for concerted action.

While we should be aware of the usefulness of slogans in calling attention to problems, we should also recognize their uselessness in solving the problems. We should

constantly push for a systems approach rather than an ad hoc, simple, problem-solving approach, or else we shall continue to see new problems created as fast as others are solved. And we should be intelligently supportive as well as intelligently critical of regulatory decisions.

As a first step, I would suggest the formation of interdisciplinary study groups to examine sympathetically, but critically, recent and proposed regulatory decisions by the Food and Drug Administration, the Federal Trade Commission, the Federal Communications Commission, and the Department of Agriculture. These study groups would comprise academic representatives of the appropriate natural sciences, industrial technologists, economists, and, when indicated, social scientists.

I emphasize the word *study*, because regulatory decisions are difficult and, as the recent phosphate fiasco suggests, only scholarly examination of the alternatives permits intelligent decisions in any biological field.

II

IN the past, regulation has tended to come in the form of a reaction to the appearance of a new chemical, a new claim, a new process, or a new threat to the environment. However, the problem-solving approach, so dear to U.S. business schools and to U.S. internal as well as external operations, has serious limitations. It often entails the creation of new problems as the first one is solved. The only logical approach, in many cases, is one entailing planning rather than problem solving. Nowhere is this more evident than in preventive medicine and in nutrition, as we will see.

Similar examples could be found in conservation and in every other major biological and social field.

The cost of medical care has risen steadily over the years, from around 12 billion dollars in 1950 to about 70 billion dollars last year. Yet the average remaining lifetime of male Americans at age 20 has remained essentially constant, while that of much of the rest of the world has increased. With regard to this vital parameter, we have slipped from 11th place in 1949 to close to 40th last year. This poor showing cannot be related solely to our unplanned, unequal medical-care setup. There is no obvious difference between medical care as received by men and women in the United States. Yet, while our women do not make a brilliant showing, they are very much closer to the world leaders (difference, about 3 years) than our men are (difference, about 7 years). Racial and economic differences in medical care are not the paramount factors in this comparison. If only the white U.S. population is considered, the women are almost level with the world's leaders, but the men are still essentially as far behind.

If we look at the causes of death, however, we can readily explain the difference. While we do have, as compared to many other developed countries, a high death rate from accidents in the home, on the highway, in industry, and from lung cancer, it is cardiovascular disease—accounting for half of the deaths in the 40- to 60-year range—that depresses our international standing.

In this regard, we have returned to the days of the great pandemics, when a fourth or half of the population died of one disease. This time, the pandemic is a degenerative rather than epidemic disease. As in the case of the Great Plague, which may have taken more than 40 million lives in Europe in the fourteenth century, the cause of the present

disaster must be looked for not only in the biological, but also in the sociological realm, with poor social planning at the root of the catastrophe.

We are, in fact, beginning to understand the multiple causes of cardiovascular diseases. All of the major causes entail both biological aspects and errors in social planning. Untreated hypertension, lack of exercise, obesity, hypercholesterolemia, and perhaps insufficient sleep, all seem to be involved. Let us examine them briefly, one by one.

Untreated hypertension affects millions of Americans. That the hypertension is undiscovered, and therefore untreated until often irreversible signs and symptoms are apparent, is attributable to our lack of emphasis on screening and preventive care. That so much hypertension arises in the first place may be due to complex social as well as biological reasons. Lack of exercise, combined with the peculiar uncertainties of American life (such as the precarious tenure of so much of our employment) and the very high salt intake of our population—further increased lately by the introduction of so many highly salted snacks and the high salt content of so many of the "convenience" foods—may be important contributing factors.

Lack of exercise is a direct consequence of the national mania for individual transportation and the introduction of power aids, not only in industry, but everywhere in the office, in the home, in the automobile, and even in recreation and sports. The golfmobile and snowmobile, for example, are the latest threats to fitness. Emphasis in urban planning on proximity of parking rather than on attractiveness and safety of walking has produced the most immobile group of men in the history of the world. Yet we know that exercise is vital to weight control.

My laboratory first demonstrated in the early fifties

that experimental animals could not regulate their food intake at very low levels of energy expenditure, but showed an appetite that stayed stuck at a minimum level as activity was decreased. The difference in energy levels accumulated as fat, a fact known to farmers who have always cooped or penned up animals they wanted to fatten.

We later extended this finding to adult men and to children and adolescents. We found, for example, that in the Boston area, relative inactivity is a much greater contribution to a positive energy balance than eating in excess of average food intake. Conversely, we were able to show in large-scale programs that increasing the daily physical activity of obese youngsters did not correspondingly increase their food intake and that we could thus reduce their body fat.

We have shown that in man, as in animals, there are a number of different forms of obesities. Some are due to regulatory error, others to metabolic dysfunction where increased lipogenesis or decreased fat mobilization may be due to a number of possible genetic or induced factors. However, it appears that, in our society, most cases of obesity have a direct social cause. Placing ourselves in an excessively sedentary condition, where the body regulators do not operate well, slowly but surely causes excessive accumulation of fat—particularly in certain inherited body types.

Hypercholesterolemia is equally related to social factors. The work of Karvonen in Finland, and that of Gsell and Mayer in Swiss populations, has demonstrated the relation of physical exercise to cholesterol. Our work suggests that an exercised population is better able to tolerate a diet high in cholesterol and saturated fat, which is characteristic of the United States and various sections of Western Europe,

than is a sedentary group. It appears that precisely as our population becomes more and more inactive, the type of diet that we have become used to—rich in animal products, high in saturated fat and cholesterol, with large amounts of saturated fat used in culinary preparation—is one that promotes atherosclerosis. The high intake of sugar in our population (100 pounds per man, woman, and child per year in the United States) not only contributes "empty calories" to the national obesity problem (it is the equivalent of 57 pounds of body fat per year) and adds to dental caries, it may also entail special risks of hypertriglyceridemia for susceptible individuals.

Finally, lack of exercise, besides its indirect effect through the increase in risk of obesity, hypercholesterolemia, and hypertension (and perhaps lack of sleep, aggravated by the availability of late TV shows) has a direct unfavorable effect on the cardiovascular system. The work of Eckstein, Lown, and others has shown that exercise may delay the progression of coronary artery disease, or stimulate the growth of coronory collateral vessels during the disease process, or both. The work of Morris in England with bus drivers and bus conductors, and with rural mail clerks and rural delivery mailmen, confirms the beneficial effect of exercise on cardiovascular mortality. Taylor, studying U.S. railroad employees—clerks, switchmen, and section hands—also found that mortality from arteriosclerotic heart disease was inversely correlated with the physical characteristic of each class of work.

It thus becomes obvious that we are spending more and more money in the medical-care system to correct diseases that we are promoting through poor social engineering. We are in the process of abolishing all physical exercise—

even in occupations that were traditionally considered arduous labor.

Yet we have inherited from hundreds of millennia of pre-agricultural times a body able to roam vast stretches of wilderness in the pursuit of herds of game, migrate from Central Asia to the shores of the Atlantic or the Pacific, cross deserts and climb mountains, and run for its life for days and sometimes nights to escape pursuing enemies. It is only in the past few millennia that we have been engaged in the only slightly less exacting pursuits of fixed agriculture, and in the course of the past 50 years that our physical activity has suddenly dropped to nearly zero.

Little wonder that our bodies, which were never selected during the eons of the cave age to sit at a desk without developing obesity and atherosclerosis, are poorly adapted to this precipitous change. It is obvious that we must replace, at least in part, the labor of our ancestors by sufficient exercise to bring our bodies back to optimal function.

This will necessitate completely different planning—such as physical-education programs that emphasize sports people will want and be able to practice all their lives, rather than concentration on team sports that often exercise only a few and condition our population to become spectators as they graduate from high school or college. We will need to plan communities where walking is pleasant and safe and where facilities for adult exercise are available and easily reached.

Similarly, we must turn our food supply around, using our technological capabilities to produce meats and convenience foods lower in saturated fat, lower in salt, and, in many cases, lower in sugar. This can be done in modern industry without any decrease in palatability, though we will often require considerable research in food technology

as well as imagination in the use of seasonings and condiments.

Until recently, the spread of unenriched snacks high in saturated fat and salt or sugar, and of high-fat, high-cholesterol, and high-salt convenience foods, has accentuated rather than decreased our nutritional difficulties. But the same application of technology can help us solve our problem provided we have a master plan agreed on by consensus or enforced by the regulatory agencies. The massive increase in the use of enriched rather than unenriched flour in snack foods, voluntarily effected by the industry since the White House Conference on Food, Nutrition, and Health, is an encouraging sign that we can improve our food supply.

Also encouraging are the large-scale experiments in labeling presently undertaken by various marketing chains, with the cooperation of academic nutritionists, consumer groups, and the F.D.A. But, if we are going to make a significant dent in our major health problem, we badly need better planning both in regard to our national exercise policy and our national food policy.

III

WE have just discussed methods—the problem-solving approach, the regulatory approach, and the planning or "systems" approach. Belatedly, let us recognize that before we discussed the means we should have discussed the end. For we will not find a consensus before we agree on an ethos. In health, we have not really agreed how far we want to go to prolong by even a few weeks the life of the incurably sick or the extremely aged. I would suggest, there, the

Hippocratic target: "The aim of medicine should be to have one's patients die young—as late as possible."

In regard to Nature, or as it is now called (anthropocentrically), the Environment, when I listen to laymen and to my biologist colleagues, I hear two entirely different themes.

In the United States at least, the preponderant message harps on the threat to the health and to the continued existence of *man*. The relatedness of every living creature to every other living creature is emphasized mainly to remind the audience that if some species have been exterminated or are being exterminated, this indicates that man is threatened—either directly by the same agents, which will sooner or later overcome a higher human threshold of toxicity—or indirectly through a long chain of intermediary disturbances in the food chain or in the mutual predation of pathogenic species.

The ambiguity created by the abominable modern practice of eliminating prepositions in the designation of Government agencies lends itself to the interpretation that this new Environmental Protection simply means protection of man *from* the Environment, rather than protection of the Environment from man.

The other theme is thin, uncertain, and perceived only now and then. It is the theme of the value of animals and of the need for their survival for their own sake, because they, too, are creatures of Nature—of God if you please—endowed with motion, with sensitivity, with courage, with the instinct to live and to procreate, our relatives and friends embarked with us on a long cruise in the middle of an empty frozen waste punctuated with radioactive fires.

Every now and then we observe episodic concern. We worry about the survival of the whales, those magnificent

mammals with those strange and melancholy voices tenderly nurturing their young in the difficult stretches of the Arctic seas. We are indignant at baby seals' being clubbed to death or at the last snow leopards' being hunted down and shot so that thoughtless pampered girls living in prosperous overheated towns can sport the inanimate skins as conspicuous displays of unearned wealth. We deplore the massive numbers of marine birds' being asphyxiated and drowned by the sudden spread on the familiar sea of a lethal flood of petroleum released by the malfunction of the tools of a voracious and careless civilization. And we sometimes try to stop the last, straggling, hungry foxes in the suburban landscape from being killed after an exhausting chase by dozens of baying hounds and pink-liveried worshippers of an uncaring past.

These outbreaks of indignation seldom seem to coalesce into a coherent ethos of protection of Nature qua Nature, of the *rights* of animals or at least of species to survival, to sufficient space to feed and breed unhampered, and to freedom from new threats from an encroaching technology. We always fall short of agreeing on a Bill of Rights for animals—an equivalent of "life, liberty, and the pursuit of happiness," if not for individual animals, at least for enough representatives of each species, or for the species itself.

The fact is that the traditional Judeo-Christian philosophy, which so completely permeates Western thinking—its traditional religion, its Marxist heresies, and its ethical agnosticism—gives us essentially no guidance for the treatment of animals and the conservation of Nature. After Genesis I—the appearance of the "moving creatures in water . . . the great whales . . . the winged fowl . . . beasts and cattle," with the solitary exception of the story of Noah's Ark, animals come into the Old or the New Testa-

ment only as sources of food, leather, or wool, or as symbols for man as in the story of the lost sheep. Even though the Middle East is hardly the most luxuriant natural area, even though so many of the more important episodes of both the Old and the New Testament take place in barren areas, the naturalist shivers at the absence of Nature in so much of the text. It is indeed "the voice of He who cries in the desert."

The exception, I have said, is the story of Noah's Ark, where the Lord commands Noah to save unclean beasts—which are not useful to man—as well as clean beasts and fowls—"to keep seed alive upon the face of all the earth." And after the Flood, Genesis 9, God established his covenant not only with Noah and his descendants, but also "with every living creature that is with us," the fowl, the cattle, and every beast of the earth. After Genesis 9, we fall into an endless genealogy, and from then on to the Gospels and the Revelation of Saint John the Divine, we deal exclusively with what common parlance calls "interpersonal relations."

In general, none of the later contributions to Western religions or ethical thinking have deviated from the basic scriptural preoccupation—the relation of man to man, the relation of man to society, or the relation of man to a personal God. The Platonic infusion brought into Christianity the dualist nature of man and the universe. The Manichean influence operating through Saint Augustine further separated the common body of man and the animals from the uniquely human soul. Thomist scholasticism taught a "natural law" which had little or nothing to do with Nature. The completely anthropocentric movements of the Reformation and the American, French, and Russian Revolutions all confirmed the unspoken

consensus that ethics is concerned only with one's treatment of one's *human* neighbor.

The message of Saint Francis of Assisi, lovable though he was, is not altogether clear. To us as biologists, the concept of brotherhood, apparently on similar terms, for our delightful fellow homoiotherms, the birds, and for a big pile of lifeless rocks like the moon, lacks, as we say, specificity. The message of Albert Schweitzer in "Reverence for Life" is close to the essence of a workable ethic, though it remains untranslated into any definite precepts.

The nineteenth-century movement against individuals' acts of cruelty to animals culminated in legislation, which oddly enough antedated similar legislation concerning children. But it was an emotional reaction to barbarous incidents rather than a witness to the birth of an ethic or a theology of man and Nature. The Conservation Movement was ambiguous from the beginning. It was championed in the United States by a president who had traveled all over the world to kill animals for sport. It has never achieved in the public mind a balance between the aim of making the world a safe place for the preservation in the free state of animal and plant species, and that of better managing hunting and fishing resources.

Societies other than the Western—such as the animist cultures and those hundreds of millions of Asians who believe in the transmigration of souls—have a better basis for an ethic of conservation of our living planet. Unfortunately, on an individual basis, a belief in the transmigration of souls, while it forbids the act of killing, does not always translate itself into a humane attitude towards the living animals. More important, it has not yet been translated into a general, large-scale philosophy of conservation, in a century where the killing of animals and the

disappearance of species usually takes place through indirect means. Beliefs in soul transmigration and animism are in full retreat before the spread of science and technology. Whether the ethical message will survive the theology is by no means assured.

In the United States, after the brief honeymoon of the first Thanksgiving, the intolerance and the greed of the white settlers led to warfare with the original Indian inhabitants and then to genocide. This human disaster prevented the newcomers from absorbing from the native Americans their philosophy of oneness with Nature and accountability for the taking of animal life. From contaminating Indians with infected blankets in Massachusetts to the extermination of the buffalo, the attitude of white Americans has been that anything that caused immediate problems for the Westward movement should be eliminated. Like our economic system, the Westward movement followed its inner logic without consideration of long-run or "natural" concerns. Hacking out of Nature an environment for man gave way to the establishment of an environment for the white man, then for industrial man, with Nature and the animal kingdom given essentially no consideration.

As biologists, we have to make sure that laws and regulations are evolved that take into account at all times the complexity and the interrelationships of all living systems. We can bring to the understanding of physiological, social, and ecological problems, minds trained to evaluate extremely complicated homeostatic systems. Those of us who are trained in medicine and public health are particularly conscious of the delicate balancing of favorable and unfavorable effects of any chemical therapeutic intervention—even when most urgently needed. We also know what profoundly deleterious changes in many aspects of

physiology and behavior can be caused by a simple and apparently useful invention. We have been trained to counsel or to take the needed action—with the prudence dictated by our partial understanding. All this we can contribute to the decision-making process in the biological field. But we can—indeed we must go farther than this.

Again, as biologists, we must insist that decisions involving our food supply, our fuel policy, our transportation system, our housing and urban planning, our recreation programs take into account biological man. By this I mean babies, children, adolescents, men and women in their youth and middle age, including pregnant and nursing women, and the elderly—as physiological and behavioral entities. We have all too often lost this sense of biological humanity—to the extent, as we have seen, of nullifying the progress of medicine by placing the human organism under conditions in which it can neither develop nor age normally. We must have a voice in the decision-making process so that biology is no longer ignored until it is too late.

As biologists, we also know better than anyone that man is one species, with rather superficial biological differences as compared to many other mammalian species—the familiar *Canis canis* for example. And we must insist both that the basic biological needs of man be satisfied—in Biafra as in Bengal as in Boston—and that man police himself as a species so that he does not become a self-destructive monster, laying waste to his world through atomic warfare or rampant overpopulation. All this has been said many times, better than I am saying it.

But tonight, speaking to a group of biologists, I want to advocate one more thesis. We must extend to the whole of the biotic world the Kantian precept that persons must be treated not as means, but as ends unto themselves.

This extended Kantian principle is particularly valid when applied to whole species. We must teach ourselves and others that dominion over the beasts and the plants of the earth entails accountability. We can do it better than anybody else because as biologists we have learned the profound unit of life—the sharing of common protoplasmic mechanisms, common cellular structure and, with various degrees of closeness depending on the closeness of our evolutionary kinship, common organ functions, common regulatory patterns, and a common integrative role for our nervous system.

We must stop feeling that we always need to justify conservation through possible usefulness to man. We will obviously tend to favor man, but we must teach our children to feel kinship for all the natural world. Anyone who has seen an osprey perching on the rocks overlooking a winter beach and a gray chopping sea can be taught to feel the intrinsic worth of this splendid animal battling for its survival and that of its species in a difficult world—and to feel anxiety and pride in the survival of this great fellow creature. Given a chance to observe it, many will grieve the progressive disappearance of urchins, sea anemones, and starfish from a polluted coast—and not just on the basis of what the death of their larvae means in terms of threat to our food chain. We must learn again to love Nature for its own sake, and we must teach this knowledge to others. And while we must become better at translating the Gospel into daily acts of love toward all our human neighbors, we have a special duty as biologists to remember Genesis:

"And the bow shall be in the cloud; and I will look upon it, that I may remember the everlasting covenant between God and every living creature of every flesh that is upon the earth."

Dr. Jean Mayer, a world authority on obesity and energy metabolism, is Professor of Nutrition and Lecturer on the History of Public Health at Harvard University, and a member of its Center of Population Studies. He is a member of the President's Consumer Advisory Council.

Dr. Mayer was appointed, in June 1969, as Special Consultant to the President and charged with organizing the White House Conference on Food, Nutrition, and Health. His leadership was a vital factor leading to its success in evaluating the nutritional needs of the American people and laying the basis for a national nutrition policy.

Born and raised in Paris, France, the renowned nutritionist earned degrees from the University of Paris and the Sorbonne, and from Yale University. He has served in various leadership and advisory capacities with the United Nations, and on the editorial boards of numerous professional journals in the fields of nutrition, physiology, and medicine. He is a Fellow of the American Academy of Arts and Sciences and a member or Fellow of a number of other professional and honorary societies. He has lectured extensively both in this country and abroad.

Dr. Mayer, a United States citizen, has been on Harvard's faculty since 1950.

Dr. Mayer is the author of more than 400 research articles and reviews, dealing mostly with the problems of hunger and obesity, both in experimental animals and in human beings.

Previous Lecturers

1968 Dr. Artturi I. Virtanen
Director, Biochemical Research Institute
Helsinki, Finland
addressed the Federation of American Societies
for Experimental Biology
Atlantic City, N.J., April 16

1969 Dr. Albert Szent-Gyorgi
Director, Institute for Muscle Research
Marine Biological Laboratory, Woods Hole, Mass.
addressed the American Chemical Society
New York, N.Y., September 10

1970 Dr. Philip Handler
President, National Academy of Sciences
Washington, D.C.
addressed the Third International Congress
of Food Science and Technology
Washington, D.C., August 11

Agricultural Research Service
U.S. Department of Agriculture
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